Amendments to the Specification:

The amended version are presented below:

INVENTION TITLE

Immersion Optics Fluid Dispenser

DESCRIPTION

BACKGROUND OF INVENTION

1. Field of the Invention

This invention relates to the need to provide an instrument to simplify and accurately dispense ~~the application of~~ and/or remove immersion fluid for ~~immersion optical~~ microscope systems.

2. Description of Prior Art

~~No mechanism exists to accomplish the task of dispensing the immersion fluid. Presently, the fluid is dispensed manually utilizing an eye dropper or its equivalent. For upright microscopes, it is not uncommon for excessive fluid to be dispensed on the specimen using this technique. When using an inverted microscope, the user must apply the drop of fluid on the objective lens which can be partially obscured as it is nested inside, or below, the microscope stage.~~

To obtain higher resolution of images when performing microscope analyses, greater numerical apertures are desired. Implementing the use of immersion optics attains these goals.
This requires the user to place the immersion fluid between the objective front lens and the specimen to fully occupy the lens-to-specimen interface. (When using an upright microscope, the fluid drop is placed on the specimen. In the case of the inverted microscope, the drop is placed on the front lens surface.) Excessive fluid creates a sloppy working environment; too little fluid is deleterious to the purity of the optical system.
It is important that the microscope user maintain continuous eye-to-specimen contact during the fluid application to eliminate a visual search procedure to relocate the item of interest. Similarly, no repositioning of the stage should occur so that the field-of-view remains unchanged.

It should be noted that a common operational procedure is to rotate the objective turret to a low power objective for general scanning. Once an item of interest is established, the higher-powered immersion objective is rotated into use. This back-and-forth search and analysis method is repeated continuously and demands that the dispensing system can operate without requiring the user to interrupt his eye-to-specimen contact.

While this fluid-dispensing chore can be manually performed easily when using upright microscopes, the task can be exceedingly difficult for an inverted system. The stage of the inverted system presents a mechanical hindrance limiting the viewing and physical access to the lens location. Since the lens is located below and/or internal to the stage, the operator cannot see the lens. The operator is required to awkwardly bend over and then to attempt to apply the fluid to the partially obscured lens. Further, it is not feasible to rotate the lens turret for the application of the fluid, since the lens surface will not then be parallel to the x-y plane and the fluid will tend to run off the lens.

Amos (3,837,731) achieved the fluid application by designing a mechanical enclosure that is rigidly attached to the objective lens. This combined assembly is lowered to the specimen to totally engulf the lens- to-specimen interface. The immersion fluid is then pumped into the enclosed space. The shortcomings of this approach are many; it is not compatible with today's objective turrets, does not permit easy interchange of objective lenses, must be selectively tailored to fit different microscopes/lenses, a direct view of the specimen is obscured, and it is not applicable for inverted microscopes.

Fowler (5,574,594) has established a marking system that could double as a fluid dispenser at the specimen's point of interest. However, this method mimics the Amos mechanical marriage to the objective lens and therefore has similar disadvantages. In addition, mechanical interferences negate this approach when using high power objectives with their small working distances.

None of these systems has an integrated extraction capability or can be mechanically interfaced with today's turreted objective lens assemblies.

Hodges (5,066,114) has arrived at a high-refractive objective lens system wherein the fluid is contained internally in a multiple lens array and completely fills the chamber containing these lenses. It essentially develops a dedicated, inflexible microscope that is pre-configured for a singular application. While this is an integrated immersion optics system, the concept is not applicable or adaptable to the general family of commercially available microscopes.

Reiner (6,196,686) presents a design that is dedicated to the viewing of the inside of an eye. It requires the replacement of the simple objective lens with a compound marriage of additional lens, fiber optic illumination, and fluid ducting. The goal is to allow surgical procedures to performed to the eye with enhanced suppression of light reflections and in a non-interfering manner. This system is not applicable to general analyses of specimen slides by conventional microscopes.

Bowman (5,233,197) uses a computer-driven system to position the objective lens at a desired location on the specimen slide. There is no requirement to perform this action when using a microscope for general immersion optical analysis. It is only important to fill the interface with immersion fluid between the objective lens and the specimen without regard to their relative locations.

Rolland (2004/0180299A1) has generated a lithography system that uses immersion optics to attain high numerical apertures. The theme of this patent is the use of immersion optics as applied to semiconductor lithography. No mechanism is described that simply deposits or removes the array of immersion fluids mentioned. The primary extraction technique employed is to use carbon dioxide to remove or dry the fluid on the semiconductor substrate.

The need for a simple, mechanically non-invasive system to accomplish the placement and removal of immersion fluid for the universal family of microscopes employing immersion optics remains an unsatisfied task.

DETAILED DESCRIPTION

Figure 1 is a functional diagram of the dispensing system for an inverted microscope. The desired immersion fluid is contained in the reservoir 1. Whenever the peristaltic driver is actuated, fluid is drawn into the peristaltic processing chamber 2 and pushed out through the dispensing port 3.

The mechanical actuator is a two-stage device with an upper section 4 and a lower section 5. Both sections share a common pivotal axis. The upper section contains a constrained spring 6 that initially forces the upper section to rotate in concert with the lower section.

As the flexible driving plunger 7 is initially displaced, it rotates the complete assembly about the pivot and positions the output port of the fluid dispenser into position above the front objective lens 8. At this point, the upper section encounters the fixed stop 9 and ceases rotating. Further displacement of the plunger causes the lower section to overcome the spring's static force. The lower section continues to rotate and a linear actuator 10 drives the ratcheting roller bearing assembly 11. By peristaltic action, the immersion fluid is squeezed from the peristaltic chamber 12 out through the dispenser outlet port.

The fluid removal process mimics the mechanical positioning events of the dispensing cycle. However, when the coaxial arm 13 is in position over the lens, a vacuum source is activated at the vacuum port 14 that causes the previously deposited fluid to be extracted from the lens surface.

For upright microscope systems, the same operational sequence of events would be invoked. However, the fluid would be deposited on the specimen slide rather than the objective lens surface.